DOCUMENT RESUME

ED 270 746 CS 209 751

AUTHOR Langston, M. Diane
TITLE New Paradigms for Computer Aids to Invention.
PUB DATE Mar 86
NOTE 12p.; Paper presented at the Annual Meeting of the Conference on College Composition and Communication (37th, New Orleans, LA, March 13-15, 1986).
PUB TYPE Speeches/Conference Papers (150) -- Reports - General (140)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Artificial Intelligence; *Authoring Aids (Programing); Cognitive Processes; *Computer Assisted Instruction; Computer Software; Creative Thinking; *Discovery Processes; Programing; *Rhetorical Invention; *Writing Instruction
IDENTIFIERS *Software Evaluation

ABSTRACT

Many people are interested in computer aids to rhetorical invention and want to know how to evaluate an invention aid, what the criteria are for a good one, and how to assess the trade-offs involved in buying one product or another. The frame of reference for this evaluation is an "old paradigm," which treats the computer as if it were paper, but new paradigm aids should be based on the uniquely electronic strengths of computers. As more and more people use computers as a primary means of creating texts, electronic media are also changing how information is being created. Commercial software offers a potential source of new technological paradigms. For instance, the emphasis on the fluidity of information in electronic forms means that information is more malleable; parts of one electronic document can become parts of another. Other technological developments that may have promise for computer aids to invention are simulation, interactive videodiscs, advanced workstations such as the IBM PC RT and the software that runs on them, and interactive computer games. In terms of invention theory, new paradigms might be found Walter Ong's "secondary orality" and Herbert Simon's and others' work on artificial intelligence. This frame of reference should aid in creating the tools that are the promise of computer aids to rhetorical invention. (SRT)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ED270746

New Paradigms for Computer Aids to Invention

Paper presented at the
Conference on College Composition and Communication
New Orleans, Louisiana
March 13-15, 1986

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

M. Diane Langston

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

M. Diane Langston
Information Technology Center
Carnegie Mellon University

CS 209 751

New Paradigms for Computer Aids to Invention

M. Diane Langston, Carnegie Mellon University

Abstract

In this paper I describe a framework for examining computer aids to invention. The framework is intended both as a way of evaluating invention aids and as an instrument for exploring the new paradigms which will lead to the invention aids of the future.

New Paradigms for Computer Aids to Invention

M. Diane Langston, Carnegie Mellon University

Introduction

As you probably know, there's a good deal of debate in the discipline about the state of computer aids to invention: whether the ones we've seen so far are useful, whether new ones can be designed which are substantially different from them, and even whether we should have invention aids at all. On one end of the scale, I've talked with many people in the last year who are very interested in computer aids to invention and want to know how to evaluate an invention aid, what the criteria are for a good one and how to assess the tradeoffs involved in buying one product or another. They are wondering, among other things, where we are going with computer aids to invention and how to talk about the issues involved with them.

At the other end of scale, I recently received a piece of computer mail which represents the position that computer aids to invention are useless and should be allowed to die out completely as a genre:

> Dear DLangston - About invention: I suspect (and would perhaps argue) that the "problem" of invention is ties (sic) to two residual "problems" in writing instruction. The first has to do with teaching "college writing," an artificial kind of scribing that neither teachers nor students are very happy about. Thus the need for props like "invention." The second has to do with "topic" writing, in which the subject, the book, the assignment is more important than the writer. If the titlee (sic) title is crucial, and the poor kid in the back row doesn't know (or care) about it, then helping that poor kid "discover" something that will spur a five-paragraph theme is important. If, however, what the learner wants to say is at the topof(sic) the priority list, then coming up with an artificial "invention" isn't really necessary. If these are problems, and if they are starting to fade just a little, then the gradual waning of excitement about ways to teach "invention" may make sense.

Of course, this view of invention is not original with the person who sent this mail message. Its earliest articulation appears in Sir Francis Bacon's *The Advancement of Learning* which was published in 1605. Bacon and the "new science" rhetoricians who came after him (Fenelon, Smith, Campbell, Blair) ignored the classical *topoi* or played down their importance for the same reason. As Bacon puts it,

> ...to him who has little or no knowledge of the subject proposed, places of invention are of no service; and on the other hand, he who is ready provided with matter appliable (sic) to the point in question will, even without art and places of invention (though perhaps not so expeditiously and easily), discover and produce arguments. (Wallace, 1947, 55)

Unlike the writer of the mail message, however, Bacon believed that a certain kind of invention was worthy of study. Although he felt that the invention of Speech and Argument (as represented by the *topoi*) was only useful as an aid to recall, he felt that it was

important both to study and to teach a second kind of invention, that of the Arts and Sciences which helps us to discover things we do not already know. It is this second kind of invention which I hope will come to characterize our new computer aids to invention and, make them exciting and useful while opening new avenues for creative thought. However, in order to produce such invention aids, ones which take full advantage of the strengths of electronic media, we must expand our view of what invention aids can and should be, and that change in perspective is the subject of my talk.

If you came today hoping that I would tell you what I think the new paradigms are going to be, you'll be surprised to hear that I will hardly be mentioning my own opinions about that at all. That's not because I'm poorly prepared or because I don't *have* opinions; I have a paper that contains my opinions coming out later this year in *Rhetoric Society Quarterly* (Langston, 1986b). If you'd like to see an early draft of that paper, I'll be glad to send you one, and I'll also solicit your comments and criticisms about it.

Rather than give you my own opinions, I want to offer you a framework or a frame of reference so that you start exploring what *you* think the new paradigms for computer aids to invention should be and then share your ideas with others like myself who are interested in what the future may bring. To get such an exchange of ideas underway, we need a common framework in which to discuss the issues. Once we have a framework, we can use it both as a critical tool for assessing invention aids and as a heuristic for thinking up new ones. My emphasis in this paper is on the latter use, the heuristic one.

Today I want to suggest one such frame of reference for organizing and conveying your own creative ideas about what the new inventional tools should be like. Along the way I'll be mentioning ideas that I and others have had, but I won't be detailing them because my interest in this paper is in *explaining* the framework, not in *using* it. However, I refer to my own work in several places so that if you're interested, you can find the papers in which I document and support my views and share the ideas which I have developed from using this framework as a heuristic.

A Frame of Reference

The framework that I'm proposing rests on what I see as a paradigm that has characterized most of our invention aids up to now. It's a consistent paradigm, a largely unconscious one, a perfectly natural one, and also a problematical one. I call it the "old paradigm" and I define and discuss it at some length in a bibliographic essay that will appear in *Rhetoric Society Quarterly* soon (Langston, 1986a). The fact that the old paradigm exists is not in itself troublesome: it is a natural consequence of early development efforts in the domain. The problem comes when the old paradigm becomes the model for the new products, instead of the starting place from which new forays and innovative designs are initiated. I believe that moving beyond the old paradigm and thinking about computers in a different way will allow us to see some exciting new possibilities for invention aids.

The defining feature of the old paradigm is that it treats the computer as if it were like paper. By contrast, I hope that new paradigm aids will be based on the *uniquely electronic* strengths of computers--things that they allow us to do that would not be possible with paper.

The Old Paradigm: Paper

Old paradigm aids are for the most part simply paper-based strategies for facilitating invention transferred to the computer. This assertion is perhaps best supported by examining the objectives that developers have claimed are met by their aids. Hugh Burns, for example, says that well-conceived computer aids to invention would be "a viable *supplementary* tool for composition teachers to aid their pedagogical repertoire" (Burns and Culp, 1980; italics mine). The goal is not to expand the teacher's repertoire but to facilitate the use of the current (paper-based) repertoire. Similarly, Dawn and Raymond Rodrigues have made the case for computer aids to invention in these terms:

> Viewed collectively, computer-based invention programs ... promise to help students understand and use heuristics for invention *with more facility* than typical classroom instruction allows them to develop.... With computer-based invention programs available throughout the day, students could *review invention strategies* whenever they needed help in generating ideas ... (Rodrigues and Rodrigues, 1984; italics mine)

Let me emphasize that observing that old paradigm exists is not the same as criticizing the aids that reflect its features or the designers who created them. These people were the pioneers; they took the initial steps toward developing computer aids which will make the new paradigm aids possible. Many of them are at the leading edge of new developments--just where you would expect a group of pioneers to be.

However, like any paradigm, this old paradigm for computer aids to invention has some built-in limitations. Describing the paradigm lets us see those limitations and the issues raised by them as we prepare to move ahead. In particular, the old paradigm raises two kinds of issues for subsequent development. First, viewing the computer as it if were like paper limits the possibilities that we see and exploit in it. Second, it encourages us to import paper-based inventional heuristics rather than creating new ones.

From a technological standpoint, much of our early research into using the computer in the writing classroom emphasized the similarities between writing with the computer and writing with paper. Colette Daiute, for example, has stressed that the computer alleviates the physical discomfort of writing on paper:

> The capacities of the computer text editor help writers avoid cramps and other physical problems related to writing. The most important feature of the text editor is that its capacity to alter the text and the format eliminates physical difficulties involved in recopying. (Daiute, 1983)

Similarly, early question-asking inventional programs such as those by Hugh Burns used the computer as a storage medium in the same way writers have always used paper (Burns, 1979; Burns and Culp, 1980). These programs presented a question, trapped the user's typed input with little or no checking, and presented the next question. The questions were sometimes presented in a fixed order as a list, one after the other, in just the same way as if the student were reading the list of questions from a piece of paper and handwriting the answers. Some programs randomized the presentation of the questions, which was only a nominal improvement since it still left the student with no control or even insight into how the questions were presented. Other inventional programs which do not ask questions, such as freewriting, invisible writing, and some association programs, use the computer for the same basic storage purpose.

From a theoretical standpoint, it is easy to demonstrate that the heuristics that underlie almost all the existing invention aids are the same ones used in a paper-based format in contemporary textbooks. These heuristics include the *topoi*, the questions from the tagmemic grid, freewriting or looping or cubing, the journalist's questions, and free association.

Of course, several of our earliest invention aids break away from this old paradigm and take some advantage of uniquely electronic strategies. SEEN by Helen Schwartz is a good example, built as it is on the networking and bulletin board capacities that computers offer. However, I think that enough of the existing aids conform in one sense or another to make the old paradigm a discernible trend or tendency in the design of those aids.

Trouble in Paradigm

What's so bad, you might ask, about using the computer as if it were paper or importing paper-based inventional heuristics? In a sense, nothing. Transferring paper-based strategies to electronic media is a natural first step in applying computer technology to any field. Paper-based inventional heuristics are proven performers which have stood the test of time, some of them for as long as 2,500 years.

However, paper-based inventional tools are only the beginning, and if we treat them as if they are the last word, we will never achieve the potential that computer aids to invention really offer us. As we become more adept at using electronic media, we need to develop inventional tools that take advantage of the computer's unique strengths. We need to move beyond computer tools which are based on paper and develop tools which are *uniquely electronic*--tools which would not have been possible with paper.

Paper-based inventional systems are based on the strengths of writing as a technology. As Walter Ong and Eric Havelock have noted, writing thoughts down on paper allows us to hold them in place and give them a spatial dimension so we can move them around, sharpen them, and define them precisely (Ong, 1982; Havelock, 1963). It is no accident that many of our inventional heuristics theories are based on definition. Precise definition only becomes possible when paper becomes a medium for holding thoughts in place, when the literate society beings to replace the oral one and writing skills are widely disseminated across the population. Inventional heuristics such as classical and tagmemic ones which are based on definition were made for a paper-based world. They are not bad or problematical in themselves; they are simply insufficient to take full advantage of the strengths of electronic media, which will bring with it changes in how we create and manipulate our knowledge, and therefore will change how we invent.

This has historically been true in the periods in which major technological shifts were taking place, such as the introduction and dissemination of writing as a technology in the fourth century and the introduction and dissemination of print technology in the sixteenth and seventeenth centuries. Ong has chronicled both shifts in *Rhetoric, Romance and Technology* (Ong, 1971) and *Orality and Literacy* (Ong, 1982).

The computer as a technology offers us unique strengths of its own, distinct from the strengths of paper, and will inevitably bring changes with it. Widespread use of computers is already altering how we manipulate information; that's a technological change. However, as more and more of us begin to use computers in our everyday lives, perhaps as our primary means of creating text, electronic media will also change how we create information.

how we come to know; that's a theoretical change. Both these changes are part of the emerging new paradigm for computer aids to invention.

The New Paradigm: Uniquely Electronic Strengths

The new paradigms will have as their defining feature the use of capacities and strategies of electronic media which are not available using paper.

Technological paradigms

In our search for new technological paradigms, we would do well to look to the world of commercial software. The programmers who are building commercial tools have a vested interest in exploiting new technologies to the limit; that's their job. In commercial software, we see distinctly a progressive movement away from paper as a model for new products and toward uniquely electronic strategies.

What are those new strategies? I will give a couple of examples here to show what I mean, and then I hope that you will take a critical look at new software products and see what they have to offer for computer aids to invention.

One new strategy in commercial software is a new emphasis on the fluidity of information in electronic forms. This fluidity gives the user the ability to combine and recombine bits of stored information in new, unexpected ways that we would probably would never have thought of using paper. With paper, information gets fixed into place: fixed into a sequence in a document, fixed into spatial relationships with pictures and diagrams. With electronic media, information is much more malleable; parts of one electronic "document" can become parts of another document and no one ever sees the places where the seams would be if you had cut and pasted the pieces of paper.

Commercial software takes tremendous advantage of this new fluidity. Text editing programs make a powerful use of it with their moving and inserting commands; database management programs operate on this principle by letting you pull out just the part of the database where you mention a certain word, for example; integrated software packages allow you to take the very same piece of information (say, a text) and use parts of it in a spreadsheet, text edit parts of it, print parts of it, send parts of it as mail--all without ever disturbing the form of your original piece of information. When was the last time you tried doing that with information written on a piece of paper? Truly, the new strategies for information management that we see embodied in our commercial software are a new technological paradigm, a uniquely electronic one that could not have been devised using paper.

Apart from information management, there are new paradigms emerging from electronic communication as well. Dawn Rodrigues gave a paper at least year's CCCC about using modems and online databases with students doing research papers (Rodrigues, 1985). Helen Schwartz was among the first to explore what computer bulletin boards and mail could offer with SEEN (Schwartz, 1982; 1984). A group of researchers in San Diego have also been active in using computer networks to provide contexts and media for writing (Levin, 1985; Levin, et al. 1985). Other technological developments which may have promise for computer aids to invention are simulation, interactive videodiscs, advanced workstations such as the IBM PC RT and the software that runs on them, and interactive computer games. The possibilities are almost endless.

Theoretical paradigms

It's a little less obvious where we should look for new paradigms in invention theory. Ong has begun to lead the way by noting the development of what he calls "secondary orality" in the communication of the electronic age, which shares with the primary of orality an emphasis on group activities, a concentration on the present moment, and the use of formulas (Ong, 1982). Ong feels that today's communication show many of those emphases; however, he points out that secondary orality will not be the same as primary orality. Secondary orality will necessarily be informed by the centuries of abstract thought, close analysis, and precise definition that were made possible by writing and print. We may be returning, as I suggested above, to a time when the parts of a text are less fixed in space and more fluid such as they are in an oral society, but we will bring with us our accumulated history of viewing words and texts as objects, not performances, so our approach to these more malleable texts will be something different from either primary orality or literacy.

However, vigorous scholarship is already going on in several different disciplines to try to assess how computers are changing the way we think. For example, sociologist Sherry Turkle has examined how the computer has influenced our definition of the word "machine," our conception of the mind, and our vision of ourselves (Turkle, 1984). Computer scientist Douglas Hofstadter has written several books exploring our models of intelligence and how machine intelligence might differ from human intelligence (Hofstadter, 1979; Hofstadter and Dennet, 1981; Hofstadter, 1985). Psychologist Herbert M. Simon has been working for many years to use computers to increase our understanding of how people solve complex problems and learn new things (Simon, 1973; Simon, 1979).

The work of the so-called "artificial intelligence" researchers has spawned a large-scale philosophical debate in which philosophers and computer scientists such as Hubert Dreyfus and Joseph Weizenbaum are searching for the qualities unique to human beings, often listing creative behavior among them and attempting to define it (Dreyfus, 1972; Weizenbaum, 1976). Philosopher Susanne Langer explores a new epistemology for creative behavior in her *Philosophy in a New Key* (1942). Speech professor Richard Gregg has recently examined the implications of an epistemology such as Langer's for rhetoric and rhetorical invention in *Symbolic Inducement and Knowing* (Gregg, 1984). D.N. Perkins has synthesized some of the early work in cognitive science on creativity in *The Mind's Best Work* (Perkins, 1984).

Not surprisingly, these new insights are already influencing how we conceptualize invention. Recently, for example, Herbert Simon has turned his attention to the problem of invention in the sciences, sensing that an adequate model of invention is becoming a central need in the field of artificial intelligence. He and his collaborators have a new book coming out called *Scientific Discovery: An Account of the Creative Processes* which is an attempt to apply the new tools and insights he has gained from working with computers in order to discover the necessary parts of creative behavior among scientists (Langley, et al. 1986).

If we are to exploit the powers of computer technology for our discipline, we must join in this effort to characterize and understand how people invent and how creative behavior will be changed by the computer. We must take an active role in developing the new theory or theories of rhetorical invention that are implied by our most recent technological shift. As Ong has pointed out, new technologies, properly used and internalized, open new avenues for human development, new kinds of potential and creativity (Ong, 1982).

This is the promise which is lying fallow in computer aids to invention, the promise which inspired so many developers to become involved with invention aids in the first place. They sensed that the computer could open new vistas and new insights, and were disappointed when their early tools failed to do so. They were essentially correct: computer aids to invention do have the potential to open exciting new doors for us and for our students; but only if we base them on inventional theories that take advantage of the changes in epistemology which are implied by widespread use of this new technology.

I am trying to develop such a new inventional theory in my dissertation project (Langston, 1986c). I do not believe, however, that my own new theory is the only one waiting to be considered and developed. We can have any number of useful new theoretical perspectives if we are willing to take a fresh look at what assumptions underlie our current theories and alter those assumptions, replace them, consider new ones, watch people inventing and induce assumptions from that.

Contemporary inventional theory is a jungle of disassociated concepts and assumptions hanging around like vines, some new (contemporary heuristics such as the tagmemic grid and Burke's Pentad) and some carried over wholesale from previous periods of history (like the *topoi*). We should all take a role in testing these "vines" to see whether they will support the weight of careful scrutiny. It may be time to weed some of them out; certainly, it's time for some new growth. I hope that you will join me in the enterprise of taking a critical look at what we mean when we say "invention" and when we build tools to facilitate it. I believe that better, stronger tools will result from the new theoretical paradigms that we can develop.

Conclusion

I have found this "framework of the paradigms" extremely rich as a tool for exploring the possibilities for computer aids to invention, organizing my thoughts about them, and sharing my ideas with others. I hope that you'll be able to use it as you attempt to evaluate new inventional software and also as you think about what you'd like to have in an invention aid. The more people we have thinking critically and creatively about invention aids, the more likely we are to create the exciting, innovative tools that are the promise of computer aids to invention.

References

Burns, H. (1979). *Stimulating Rhetorical Invention in English Composition Through Computer-Assisted Instruction.* PhD thesis, University of Texas at Austin: ED 188 245.

Burns, H. and Culp, G.H. (1980). Stimulating invention in English composition through computer-aided instruction. *Educational Technology*, August, 5-10.

Daiute, C. (1983). The computer as stylus and audience. *College Composition and Communication*, 34[2], 134-145.

Dreyfus, H. (1972). *What Computers Can't Do.* New York: Harper & Row.

Gregg, R.B. (1984). *Symbolic Inducement and Knowing.* Columbia: University of South Carolina Press.

Havelock, E.A. (1963). *Preface to Plato.* Cambridge, MA: Belknap Press of Harvard University.

Hofstadter, D.R. (1979). *Godel, Escher, Bach.* New York: Basic Books.

Hofstadter, D.R. (1985). *Minds and Machines.* New York: Basic Books.

Hofstadter, D.R. and Dennet, D.C. (1981). *The Mind's I.* New York: Basic Books.

Langley, P.W., Simon, H.A., Bradshaw, G.L., and Zytkow, J.M. (1986). *Scientific Discovery: An Account of the Creative Processes.* ??: ??. In press.

Langston, M.D. (1986a). The old paradigm in computer aids to invention: A bibliographic essay. *Rhetoric Society Quarterly*, forthcoming.

Langston, M.D. (1986b). New technological paradigms for computer aids to invention: From paper to the uniquely electronic. *Rhetoric Society Quarterly*, forthcoming.

Langston, M.D. (1986c). *A Cognitive Model of Invention and Its Application to the Development of Computer Tools.* Dissertation in progress, Carnegie Mellon University.

Levin, J.A. (1985). Computers as media: Learning and development in a whole earth context. Paper presented at the annual meeting of the Jean Piaget Society, Philadelphia, PA.

Levin, J.A., Riel, M.M., Rowe, R.D., and Boruta, M.J. (1984). Muktuk meets Jacuzzi: Computer networks and elementary school writers. In S.W. Freedman (Ed.). *The Acquisition of Written Language: Revision and Response.* Hillsdale, NJ: Ablex.

Ong, W.J. (1971). *Rhetoric, Romance, and Technology.* London: Cornell University Press.

Ong, W.J. (1982). *Orality and Literacy: The Technologizing of the Word.* London: Methuen & Co., Ltd.

BEST COPY AVAILABLE

Perkins, D.N. (1981). *The Mind's Best Work.* Cambridge, MA: Harvard University Press.

Rodrigues, D. (1985). Beyond word processing: Other uses for computers. Paper delivered at the 1985 Conference on College Composition and Communication. March 21-23, Minneapolis, MN.

Schwartz, H.J. (1982). A computer program for invention and feedback. Paper presented at the Conference on College Composition and Communication, San Francisco, ED 214 177.

Schwartz, H.J. (1983). Hypothesis testing with computer-aided instruction. *Educational Technology*, 26-27.

Simon, H.A. (1973). The structure of ill-structured problems. *Artificial Intelligence*, 4, 181-201.

Simon, H.A. (1979). *Models of Thought.* New Haven, CT: Yale University Press.

Turkle, S. (1984). *The Second Self: Computers and the Human Spirit.* New York: Simon and Schuster.

Wallace, K.R. (1943). *Francis Bacon on Communication and Rhetoric.* Chapel Hill, NC: University of North Carolina Press.

Weizenbaum, J. (1976). *Computer Power and Human Reason: From Judgment to Calculation.* New York: W.H. Freedman and Company.

BEST COPY AVAILABLE